THURSDAY, JANUARY 19, 1899.

THE ANATOMY OF THE EARTH'S CRUST.

Earth Sculpture; or, the Origin of Land Forms. By James Geikie, LL.D., D.C.L., F.R.S. Pp. xvi + 320. (London: John Murray, 1898.)

THE sculptor must be careful to mould his drapery so that its fall and fold may accord with the form below; or, if he copies the undraped human form divine, however quick his eye to detect and his hand to represent, if he wishes to follow the curves of beauty with ease and accuracy he must know the position and functions of the muscles and bones upon which the outlines and pose of the body depend.

So in the study of scenery we shall be better able to appreciate the forms presented to us if we understand the causes which have determined them; then we shall look with different eyes on the gently rounded outlines where soft surface-drifts like drapery have clothed the solid rocks, filled up their hollows, and concealed their ruggedness. Still more shall we have the pleasures of imagination heightened when we can, from an examination of the surface, realise the "ribs of porphyry" or the "joints of the limestone" that have determined the configuration and lie of the land before us.

A very useful work for the sculptor would be "Outlines of Human Anatomy for Artists, with Dissections"; but that would not be a work on sculpture; and the book before us might not inappropriately have been called "The Morphology and Physiology of the Earth's Crust, with Sections; being an Introduction to the Study of Earth Sculpture and its resultant Scenic Features." For it includes far more than its title would imply. It is, in fact, a series of essays upon the principles of geology, in which the author keeps in view the question which on his title he has proposed for consideration; and, at the same time, gives great prominence to those aspects of the subject which bear upon certain theories towards the development and promulgation of which he has taken a leading and distinguished part.

He points out that subterranean action merely provides the rough block which the surface agents of denudation subsequently sculpture into shape, and that, with few exceptions, the land features that now meet our eye are the direct result of erosion and accumulation, the modifying influence of which is always more or less conspicuous.

As the work is intended for readers not skilled in geology, the author has not thought it necessary to burden the pages with references, which for the student are indispensable. He has adopted the *a priori* method; and a great part of the work is devoted to explaining what might, could, would, or should be, assuming the prevalence of certain conditions.

The readjustments of a hardening crust to a shrinking nucleus are referred to as sufficient cause of the foldings which have lifted large areas within reach of earth sculpture, and produced the crumplings and great variety of structure observed in many mountain chains. Perhaps mention might have been made of other theories to account for crustal movements, such as the loading of off-shore areas by sediment, and the corresponding lightening of the adjoining areas from which that sediment was derived; the theories of subterranean lakes of molten matter; the changes of volume which accompany chemical, mineralogical, thermal and other changes in the rocks, and so on.

When looking at the subject from the point of view of earth sculpture, the most important point is the more or less yielding character of the rock—whether this be due to its chemical composition as shown in the manner in which a limestone is dissolved, and rocks with potash felspars crumble away; or whether we regard its texture and structure as shown in the manner in which a shale often resists denudation, while a tough massive rock breaks along joints and bedding planes, and is thus readily cut back; or in its relation to the lie of the rocks as shown in the way in which they resist denudation better where they present solid bed-faces to the weather, than where the denuding agents can attack them along the lines of weakness between the divisional planes. Among beds which are horizontal, or only slightly and uniformly inclined over large areas, there will be a greater similarity in the resultant features than there can be if the beds are thrown into sharp folds, so that rapid alternations of rocks of different solubility, hardness, &c., are exposed in ever-varying positions within short distances. These points chiefly are elaborated in the first nine chapters.

Then we have two chapters on the modification of land forms by glacial agency. The work of ice at the present time is described and the traces of similar work in the past, over areas from which the ice has long been removed, are sketched out. It does not, however, necessarily follow that it was more generally extended over either hemisphere. We shall sufficiently account for all the phenomena observed if we admit that the scene of its severest operations has been shifted from time to time.

Among the controverted questions relating to the origin of glacial accumulations is that of the mode of formation of the ground moraine, that is the great mass of clay and rock which is found at the base of the ice, and of which relics are left plastered over the surface of many glaciated regions.

Have the larger fragments, at any rate, worked their way down from moraines and from the sides to the bottom of the ice, where, crushed against one another and driven over the underlying rock, they produce the clay which forms the matrix of the ground moraine and the "flour of rock" which discolours glacial streams? Or is the ground moraine derived chiefly from the rock over which the ice is travelling; does little material reach the bottom of the glacier or ice-sheet from its surface; and has the ice the power of extracting pieces of rock from its bed, and using them as tools to plough up or grind away more?

This last is the view which our author favours, but it involves the concession that some rock fragments mus have got in from above to start the work, as ice, like water in this respect, has practically little eroding power, but moulds itself round obstructions and only operates in denudation as a handle or back to hold the fragments of rock which form the rasp that really does the work.

Many interesting examples are cited of pieces of rock

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which appear to have been gouged out of the bed of the glacier stream, but they are all within the range of the minor advances and recessions of the ice, and still leave room for doubt in the minds of those who are inclined to the view that most of the large fragments in the ground moraine have got in from above.

The author has long been engaged in controversy on the causes and mode of operation of glacial agents, and has, as is well known, pronounced views upon the subject; but in a work of this kind we might have expected to find not merely those facts stated which support the author's theories. Yet we look in vain for a sketch of the work of icebergs, floe-bergs, shore-ice, pack-ice, &c., in handing on and distributing material from the higher ground over wide submarine areas.

We can hardly ignore the potent agency of ice-masses, such as that seen by Ross and Parry, and estimated at 1,500,000,000 tons weight, in modifying the surface of the land on which they grounded, and against which they were driven by wind and current with a velocity far greater than that attained by any glacier or ice-sheet.

Icebergs, 700 or 800 feet high, have been seen sailing along off Cape Horn, and we know that the volume of ice below the water would be between eight and nine times that seen above it. Not only must we take account of the tremendous momentum of this stranding ice, but the enormous quantity of débris now carried by floating ice and distributed over the sea-bottom would seem to deserve some notice. The fact calls for some explanation, if it be a fact, that nothing of the kind is recognised among the glacial deposits as having been raised from the sea-bed within reach of observation.

Towards the end of the work, where he is developing a classification of forms, our author gives a separate chapter on coast-lines and another on basins, which last is very much a continuation of the chapters on glacial phenomena. He accepts the glacial origin of most rock basins, though he admits that there are difficulties in reconciling this view with some of the phenomena observed in the outer Hebrides, for instance (pp. 242–244).

He describes the loess of Southern and South-eastern Russia as primarily a flood-loam of glacial times, and considers that much of that occurring in the river valleys of Central Europe has been derived from Alpine lands (p. 192). But any-one who has examined the character and mode of occurrence of the black, dusty Tchernosem of Southern Russia, covering all the surface high and low, continually blown away and washed away and ever renewed, will have his confidence in those wide generalisations as to the origin of all loess considerably shaken.

England is the country of all countries for the study of the fossiliferous rocks; America is too broad, Switzerland too high; in England the evidence is fairly complete within easy distances, and is generally accessible. So it is in Scotland that we find the most readily available epitome of the phenomena of rock-structure. It is, therefore, to be regretted that a larger portion of the illustrations were not taken from actual sections seen in Scotland or England. The work would have been more valuable if the facts could have been verified in the field in a summer's trip. As it is there are only a dozen Scotch sections, including the two excellent photographs of weathered granite, and a couple from England, while thirty-five of those of which the locality is given are taken from foreign works. The remaining forty-two have no locality—that is, are only diagrams, and those not very satisfactory.

If the glossary was intended to be confined to words used in this work, there are not many which it would not have been better to have explained or paraphrased in the text, and most of them need no further explanation than should be gained from the context; while some need not have been used at all, for it is not easy to state a case in which anything is gained by using epigene and hypogene instead of above-ground and under-ground. Of those that do seem to require a note, some—for instance, "tectonic"—are not mentioned in the glossary. But if it is a general glossary to assist those who might wish to follow up the line of inquiry by reading special memoirs, the information is not wide enough. It might have been helpful to have enabled the reader to discriminate between diorite and syenite, dolerite and basalt, and so on; and, if the origin of the word is explained, to point out that diorite was so named from the ease with which the component minerals could be distinguished as compared with dolerite which was obscure, although such rough distinctions were not those upon which modern petrologists rely for their classification.

However, after cautioning our readers that there are other interpretations of many of the facts observed, besides those offered in this work, and pointing out some slips which will probably be corrected in the next edition, we can recommend them to read this able and clearly arranged succession of essays upon an interesting group of natural phenomena.

THE OASIS OF SÎWAH.

From Sphinx to Oracle. By A. Silva White. Pp. xvi + 277. 2 Maps, and 57 Illustrations. (Hurst and Blackett, 1899.)

UNDER a somewhat fantastic title Mr. A. Silva White has published an account of a journey which he made in the early part of the present year to the Oasis of Sîwah, the Oasis that was made for ever famous by Alexander the Great, who visited it after he had conquered Phœnicia and Egypt. Mr. White's visit seems to have been prompted by an inspiration which came upon him after he had drunk deep of the "sonorous silence" of the desert, at "midnight hours," "in the radiance of a full-moon." We wish that the inspiration had been a thing born of the day, and that it had counselled him to persevere in making preparations which took the form of studying the history and languages, ancient and modern, of the land over which he had resolved to travel. His original object seems to have been to visit Jarabub, the stronghold of the powerful "Senussi" sect of Muhammadans, which lies rather more than one hundred miles from Sîwah, in a direction more west than north. As Mr. White talks of his "political studies" we may assume that he had some definite mission when he set out for this uninviting spot; we have no right to inquire what the mission was, and we can only offer him our sympathy in his failure to reach the place where he fain would have been. To this failure we perhaps owe the appearance of his work.

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